

## METHOD AND APPARATUS FOR MULTI-TOUCH TACTILE TOUCH PANEL ACTUATOR MECHANISMS

### RELATED APPLICATIONS

[0001] This application is related to the following co-pending application, which is assigned to the Assignee of the present invention.

[0002] Application Ser. No. \_\_\_\_\_, filed \_\_\_\_\_, entitled "Method and Apparatus for Multi-Touch Tactile Touch panel Actuator Mechanisms," attorney docket no. IMM272 (1054.P003US).

### FIELD OF THE INVENTION

[0003] The present invention relates to the field of electronic interface devices. More specifically, the present invention relates to a user interface device having haptic actuators.

### BACKGROUND OF THE INVENTION

[0004] As computer-based systems, appliances, automated teller machines (ATM), point of sale terminals and the like have become more prevalent in recent years, the ease of use of the human-machine interface is becoming more and more important. Such interfaces should operate intuitively and require little or no training so that they may be used by virtually anyone. Many conventional user interface devices are available on the market, such as the key board, the mouse, the joystick, and the touch screen. One of the most intuitive and interactive interface devices known is the touch panel, which can be a touch screen or a touch pad. A touch screen includes a touch sensitive input panel and a display device, usually in a sandwich structure and provides a user with a machine interface through touching a panel sensitive to the user's touch and displaying content that the user "touches." A conventional touch pad is a small planar rectangular pad, which can be installed near a display, on a computer, an automobile, ATM machines, and the like.

[0005] A conventional touch-sensitive component of a touch panel employs various types of touch sensing technology such as capacitive sensors, pressure sensors and the like as known in the art to detect locations being pressed on the panel. For example, a user contacts a region of a touch screen commonly with a fingertip to emulate a button press and/or moves his or her finger on the panel according to the graphics displayed behind the panel on the display device.

[0006] A problem associated with the conventional approach for generating a haptic feedback is relying on global motion of a mechanical carrier attached to the touch screen to produce haptic or tactile feedback. Using the global motion approach typically limits to one haptic feedback to one input at a given time.

[0007] Accordingly, there is a need for a touch panel or surface, which is capable of providing multiple tactile or haptic feedbacks in response to multiple touches simultaneously at a given time.

### SUMMARY OF THE INVENTION

[0008] A method and apparatus of actuator mechanisms for a multi-touch tactile touch panel are disclosed. The tactile touch panel includes an electrical insulated layer and a tactile layer, wherein the electrical insulated layer includes a top surface and a bottom surface. The top surface of the electrical insulated layer is capable of receiving an input from a user.

The tactile layer, which is also known as a haptic layer, a feedback layer, or the like, includes a grid or an array of haptic cells. The top surface of the haptic layer is situated adjacent to the bottom surface of the electrical insulated layer, while the bottom surface of the haptic layer is situated adjacent to a display. Each haptic cell further includes at least one piezoelectric material, Micro-Electro-Mechanical Systems ("MEMS") element, thermal fluid pocket, MEMS pump, resonant device, variable porosity membrane, laminar flow modulation, or the like. Each haptic cell is configured to provide a haptic effect independent of other haptic cells in the tactile layer.

[0009] Additional features and benefits of the present invention will become apparent from the detailed description, figures and claims set forth below.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present invention will be understood more fully from the detailed description given below and from the accompanying drawings of various embodiments of the invention, which, however, should not be taken to limit the invention to the specific embodiments, but are for explanation and understanding only.

[0011] FIG. 1 illustrates an electronic interface device or system capable of providing multiple tactile feedbacks in response to multiple touches in accordance with one embodiment of the present invention;

[0012] FIG. 2 is a top view of an interface device illustrating a haptic touch panel having an array or a grid of haptic cells in accordance with one embodiment of the present invention;

[0013] FIG. 3(a-b) illustrates a haptic cell using piezoelectric materials to generate haptic effects in accordance with one embodiment of the present invention;

[0014] FIG. 4(a-b) is a diagram illustrating another embodiment of a haptic cell using Micro-Electro-Mechanical Systems ("MEMS") device to generate haptic effects in accordance with one embodiment of the present invention;

[0015] FIG. 5(a-b) illustrates a side view of an interface device having an array of haptic cells with thermal fluid pockets in accordance with one embodiment of the present invention;

[0016] FIG. 6(a-b) illustrates a haptic cell employing Micro-Electro-Mechanical Systems pumps to generate haptic effects in accordance with one embodiment of the present invention;

[0017] FIG. 7 illustrates a side view diagram for an interface device having an array of haptic cells using variable porosity membrane in accordance with one embodiment of the present invention;

[0018] FIG. 8 is a side view of an interface device having an array of haptic cells using various resonant devices in accordance with one embodiment of the present invention;

[0019] FIG. 9(a-b) illustrates a top view diagram of a multi-touch haptic display 900 having laminar flow of fluid in accordance with one embodiment of the present invention; and

[0020] FIG. 10 is a flowchart illustrating a process of providing multiple haptic effects in accordance with one embodiment of the present invention.

### DETAILED DESCRIPTION

[0021] Embodiments of the present invention are described herein in the context of a method, system and apparatus of